MAY 16 1923

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Volume 9 April, 1923 *Number 4*

Lubrication

A Technical Publication Devoted to the Selection and Use of Lubricants

THIS ISSUE

Lubrication of Silk Mill Machinery

PUBLISHED MONTHLY BY
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LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

Published Monthly by

The Texas Company, 17 Battery Place, New York City

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Vol. IX April, 1923 No. 4

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Lubrication of Silk Mill Machinery

IN THE textile industry the manufacture of silk is one of the most important features we have to deal with, and the intricate means by which raw and spun silk are developed into the multitude of forms necessary to our daily life are interesting in the extreme. Essentially the silk industry produces and employs two distinct types of silk, *i.e.*, natural and artificial. Natural silk is the direct product of the silk worm. It differs from other textiles in that it is a continuous filament or yarn at the start, having been originally spun by the worm when forming its cocoon. In turn, natural silk products are classified as (1) thrown and (2) spun.

Thrown Silk comprises silk fibres as reeled from the cocoons before the moths have left them.

Spun Silk is, on the other hand, a waste product, being chiefly obtained from cocoons from which the moths have emerged, the silken fibres having been broken or eaten through. Thereby reeling is materially impaired and the lustre of the thread is reduced. Spun silk may also include any other natural silk which is incapable of being reeled, or fluff and cleanings recovered from the raw silk as it undergoes the process of throwing. The effort of the silk farmer is to reel from the live cocoon and obtain raw silk wherever possible. The longest, strongest and most brilliant threads are thus obtained. Each cocoon produces from 500 to 700 yards of fibre.

Artificial Silk is a product which was originally derived as a result of an effort to simulate the function of the silkworm, by producing silk in a synthetic manner. Several processes are in use which employ cellulose in the form of wood pulp, or cotton as a base. This is dissolved in a solvent and the solution is then forced under pressure through minute orifices and subsequently reeled in a similar manner to raw or cocoon silk.

Artificial silk is in general more lustrous than natural silk, and is used extensively in the hosiery and knitting industry and in the weaving of many grades of silk goods such as neckties, and other products wherein certain of the patterns require threads of greater sheen to bring out the effect.

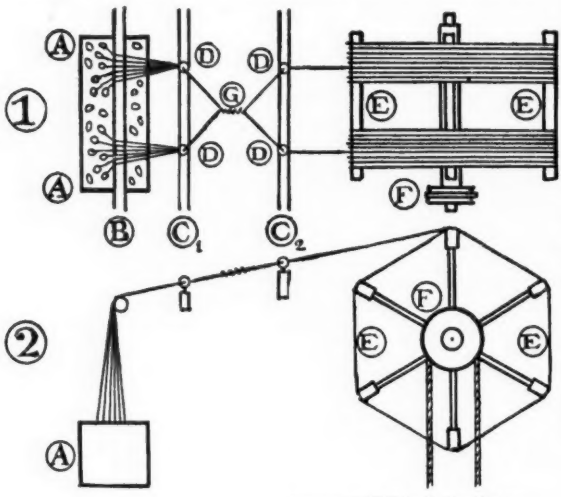
Artificial silk is also mixed with raw silk in twisting when it is desired to produce thread for certain grades of hosiery, gloves and other knit goods. Such thread knitted alone or with cotton or wool produces a fabric of the appearance of silk, but at a lower cost.

It is estimated that the artificial silk consumption of the United States is approximately 50 to 55% of the amount of raw silk imports received from the Orient and Europe.

Reeling

Reeling of the silk fibres from the cocoon is the first of the many steps which silk undergoes in being prepared for the market. It is carried out directly from the cocoon and is performed after the silkworm has finished spinning. To

attain the finest silk the cocoons must be fumed or subjected to sufficient heat to kill the embryo



Courtesy "Silk" by Luther Hooper

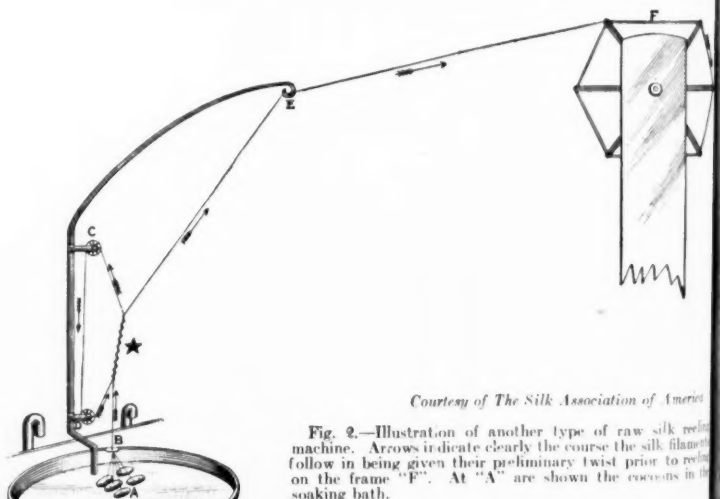
Fig. 1.—Typical Reeling Machine. At "A" is shown the soaking tank filled with hot water, wherein the cocoons are steeped. Above this tank is a glass guide rod "B" over which the fibres are drawn. "C" and "D" are other guide rods preceding and following the twist or "crossieur" at "G". The reels are shown at "E", being driven by belt attachment to pulley "F".

moths within, otherwise they will ultimately escape from the cocoon and render it only suitable for spun silk.

The actual process of reeling will vary considerably according to locality, and the devices employed are of a crudeness dependent on the degree of civilization of the community. The primary purpose of twisting is to stretch the fibres evenly and wring out excess water. Essentially the process is to soak the cocoons in boiling hot water for a sufficient length of time to partially dissolve the silk gum and free the fibres. Then the ends of these from about six or more cocoons are drawn together over a guiding rod, through suitable orifices and fastened to a winding wheel. Another set is similarly drawn, being twisted around the first at G in Fig. 1, in what is known as the "crossieur". The winding wheel completes the reel and automatically brings about a uniform twist, the operator meanwhile watching the bobbing cocoons in the soaking pan for broken fibres. The "crossieur" firmly twists the pliant threads into one and consolidates the filaments. This system of twisting two adjacent sets of fibres is known as the "chambon". In another, the "tavelette", the twisting is carried out with but one set of fibres. The "crossieur" is the basic feature and must be embodied in some manner in the modern reel whatever the design. After sufficient fibres have been reeled to make up the number of skeins as desired, the product is ready for the market as raw silk. Skeins usually weigh from 2½ to 3½ ounces and contain from 10,000 to 20,000 yards each.

Silk Throwing

The several inspection, twisting, winding and doubling processes that the silk fibres must undergo in being formed into permanent threads are generally known as "silk throwing". This is the first essential manufacturing treatment that raw silk usually receives in the textile mill before it is dyed or woven. The chief object in



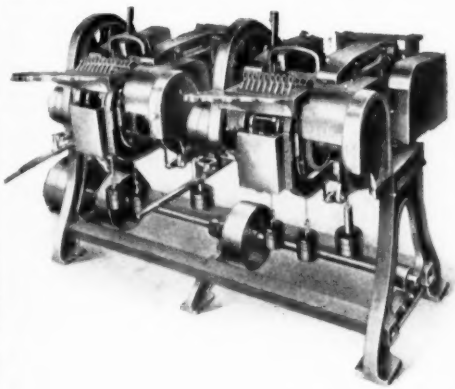
Courtesy of The Silk Association of America

Fig. 2.—Illustration of another type of raw silk reeling machine. Arrows indicate clearly the course the silk filament follow in being given their preliminary twist prior to reeling on the frame "F". At "A" are shown the cocoons in the soaking bath.

silk throwing is to insert the required twist into the raw fibres, with such doubling or folding of two or more threads as may be desired to increase the size and strength of the thread.

Approximately 80% of the world's supply of silk is used in the United States, about two

thirds of which is "thrown". Japan, however, has quite a few modern mills for throwing and weaving, and the Japanese turn out certain



Courtesy of Saco-Lowell Shops

Fig. 3.—Rear view of an intersecting gill drawing frame as used in the preparation of spun or waste silk for weaving.

plainer fabrics that are the equal of anything produced in America. Pongee, however, is the chief finished silk product exported from the Orient.

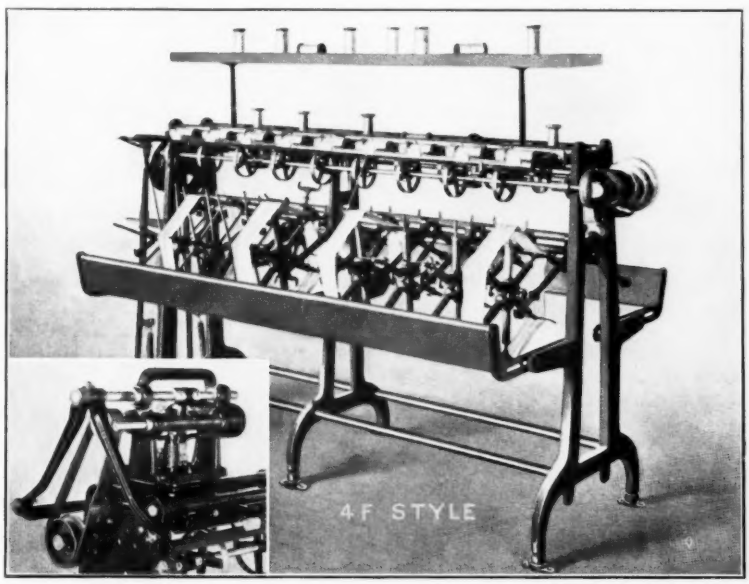
Soaking

In general practice raw silk is soaked before it is "thrown" or spun into yarn, in order to soften and slacken the gums and reel markings and render the thread pliable and ductile. For this purpose a mixture of oil, soap, borax, salt and warm water is used. The oils generally employed in this process are olive, neatsfoot, lard or a compounded mineral oil, and their purpose is to serve as a lubricant for the thread and to soften the action of the soapy mixture on the silk. Otherwise the threads would dry stiff, hard and relatively sticky. This oil is later boiled out in the dyeing process. The essential point is to use an oil that will not leave any odor, and will have sufficient viscosity to form a dependable film over the silk. According to authorities a satisfactory mineral oil compound for this purpose can be prepared, consisting of a red oil of approximately 200″ Saybolt viscosity at 100 deg. F. and 70% neatsfoot oil.

Winding

After sufficient soaking, the skeins of silk are usually dried in some form of centrifugal extractor. They are then hung out for a certain length of time, either in a heated chamber or under ordinary room temperature conditions. After this they are put on light skeleton six-arm reels, known as "swifts", which are usually adjustable. From the "swifts" the silk is wound onto bobbins. Two types of winding machines are in use today, *i.e.*, the spindle winder, having single or double head spindles, and the drum winder where the bobbin rests on a friction roll or drum. The use of "swifts" enables a perfect balancing of load and prevents racing, thus producing even and firmly filled bobbins. Drum winders usually contain from 60 to 70 spindles and carry a corresponding number of "swifts". They can be built with either a double or single row of spools as the mill requirements may call for.

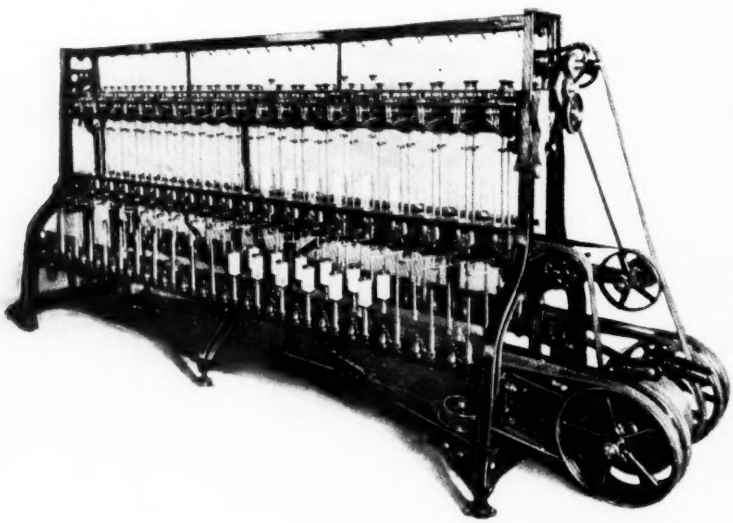
In actual operation a winder must be care-



Courtesy of The Atwood Machine Co.

Fig. 4.—Silk Winding Frame built to wind either natural or artificial silk. This machine can be either driven from overhead or by an electric motor, power being transmitted directly to the cone pulley on the crosshead.

fully watched by the operator to see that the skein runs smooth, breakages are properly pieced up, and imperfect portions of thread are removed. Drum winders are usually driven by a belt, cone pulley and cross-head, either geared or fitted with variable speed cones. Electric drive may also be adopted if desired. Bobbins



Courtesy of The Atwood Machine Co.

Fig. 5.—A Combined Silk Spinning, Doubling and Twisting Frame. This machine is built for first and second time spinning and the spindles are belt driven and self-oiling, being mounted in automatic swinging holders.

are individually driven by friction wheels. The value of friction motion in handling delicate thread such as silk is evident when we consider that the slightest momentary catch in the thread being unreeled from the swift would result in breakage if the bobbins were not able to be retarded as necessary by the tension of the thread itself.

Doubling

In this process the threads from two to ten bobbins are doubled together without winding onto an additional bobbin. The purpose of doubling is to wind these preliminary threads of relatively slender character into threads of required strength under as equal tension as possible, without twist. Doubling may be performed before or between spinning operations, according to the nature of the thread being produced.

Spinning

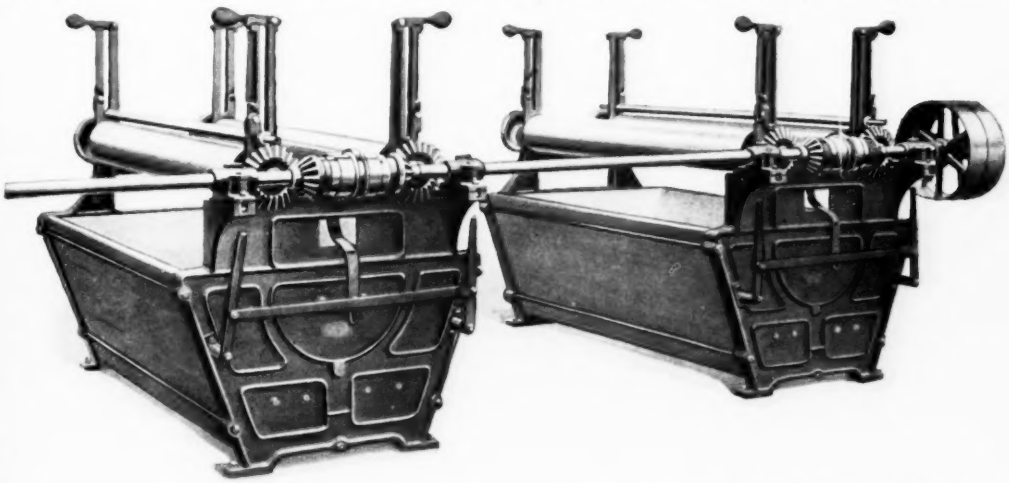
Having wound the skeins onto suitable bobbins and doubled them if necessary the next essential step in the "throwing" mill is to spin the silk into thread of suitable size and strength. Here the actual twisting of the silk into a firm compact thread takes place. Spinning or "throwing" frames are either single or double decked, being usually built for belt drive. Single deck spinners require double the floor space and power for operation, but on the other hand they are claimed to give a cleaner silk and require fewer spindles to be stopped when changing lots or repairing belts.

Spinning machine spindles operate usually at a high rate of speed, *i.e.* in the neighborhood of 10,000 r.p.m. or more. Naturally the bearing temperatures will tend to rise rapidly unless the utmost care is used both in selecting and applying lubricating oils. For this reason ball bearing spindles have been tried out to some extent, though no opinion has been formed as to their adaptability. Ball bearings, however, are suitable and economical on the heavy bearings of the spindle belt drive, and they bring about a marked reduction in driving power required. From twenty-five to thirty percent power saving has actually been accomplished under test.

In certain of the modern textile mills there is a tendency towards the usage of a combined doubler and spinner or a combined spinning, doubling and twisting machine which will take bobbins of silk directly from the winding machines and spin to the various grades of finished thread in one operation. Essentially they differ little from a lubricating point of view from the single process machines mentioned heretofore. When it is desirable to throw silk for knitting purposes such as in the manufacture of hosiery, etc., the threads are wound onto a cone instead of a bobbin, using a special type of coning machine.

Another phase of the "throwing" of silk is the matter of the number of spins that are given

For example, in the manufacture of thread known as organzine, or what comprises the "warp" or lengthwise threads in the finished textile, the thread is first spun, then doubled, and after that it receives a second spin. On the other hand, thread known as tram, or in other words the "weft" or cross thread, is doubled, tripled or quadrupled after winding; it then receives but one spinning before it is finally reeled.



Courtesy of H. W. Butterworth & Sons Co.

Fig. 6.—Dyeing machine or Jigger, for coloring silk goods in the piece. The beam rolls on this device are controlled by a special friction clutch, and the machine can be built of any width.

Steaming

To smooth, coordinate and firmly set the twist, silk is usually next subjected to steaming. That is, it is wound from the bobbins onto comparatively large reels which are then placed in a steam chamber for a suitable length of time. It is then reeled into skeins ready for dyeing or weaving. Reeling frames are built to produce skeins of from 54 to 60 inches in circumference, the latter containing up to 20,000 yards of thread each.

Dyeing

After silk has been thrown the skeins of organzine and tram may either be sent to the dye-house and colored preparatory to weaving, or they may go directly to the weaver. In the latter case the woven product is piece-dyed according to market demands much in the same manner as the skeins are treated. Both methods are extensively used. Piece-dyeing, however, is becoming more and more popular due to the trend of fashion towards soft filmy goods such as crepes, and the possible saving in time and expense involved.

As has been stated later on in discussing weaving, in the production of certain grades of silks for piece-dyeing, oftentimes the warp or organzine is woven raw without any preliminary throwing. Frequently such products are composed of a raw silk warp with an artificial weft, and two baths are necessary, *i.e.*, one to color the raw, and a second to color the artificial or wood silk. The puckery effect in certain crepe goods is obtained by the silk yarn having been so thrown that every two adjacent threads are of opposite twist. In the dyeing process the tendency of these threads to unwind gives the desired appearance to the goods.

The usual process is to dye the silk in loosened skeins or bolts after they have been sufficiently boiled or cooked to extract any adhering gums and natural coloring matter they may contain, as well as soaking oils and soap. One, two or three boilings may be necessary according to the nature of the silk and the percentage of impurities. If white silk is desired, three boilings are customary, followed by suitable bleaching. Then, in the case of skein dyeing, if the thread is to be "pure-dyed" it is passed immediately to the coloring tanks.

Frequently silk is loaded or weighted with such substances as sugar, tannins, or metallic salts to give special finishes. The process generally consists of treatment in suitable baths containing these substances, followed by a period

of whizzing in a hydro-extractor, and then washing to remove free acids which would tend to rot the threads. The purest grade of water obtainable should be used in all of the dye-house treatments in order to insure the most perfect coloring and chemical reactions, and render the silk of the desired lustre.

Courtesy of Tolhurst Machine Works

Fig. 7.—Modern self-balancing hydro-extractor as built for silk dye house service. Machines of this type are often provided with flexible bearings which accommodate themselves to unbalanced loads. Either engine, countershaft, or motor drive from above or below is possible.

Having dyed the silk, the final step is to dry it. This must be carried out carefully and moderately, after which the silk is ready for the weaver, or knitter if in skein form, or for finishing if already woven or knitted into fabric.

Weaving

Broad Silks

Although the art of silk weaving dates back to the stone age, modern weaving of broad silk may be said to have begun with the development of the power loom and the Jacquard pattern machine, the principle of which is based upon the old draw-loom in which cords were pulled as necessary by hand power. Today the power loom predominates in the silk mill where goods of any extensive length are to be produced. However, the hand loom is still sometimes used when it is desirable to turn out short-lengths of special designs. It is the opinion of some weavers that finer qualities of certain grades of silk can be produced on a hand loom with less chance of broken threads, etc.

The power loom as it is built today is similar in basic principle to the loom used in the cotton mill, which was explained in LUBRICATION for September, 1920. In brief, its function is to interlace the cross-threads or filling with the warp or lengthwise threads. Prior to actual weaving the warp must first be wound onto a beam or roll for insertion into the loom. This is simply a process of winding the skeins onto bobbins on a suitable winding machine. Then the contents of the bobbins are transferred to a large wheel known as a reeling frame. Thus any number of skeins can be joined together and warp can be produced of the desired length. After this the warp is rewound onto the beam when it is ready for drawing through the harness and reeds preparatory to being placed in the loom.

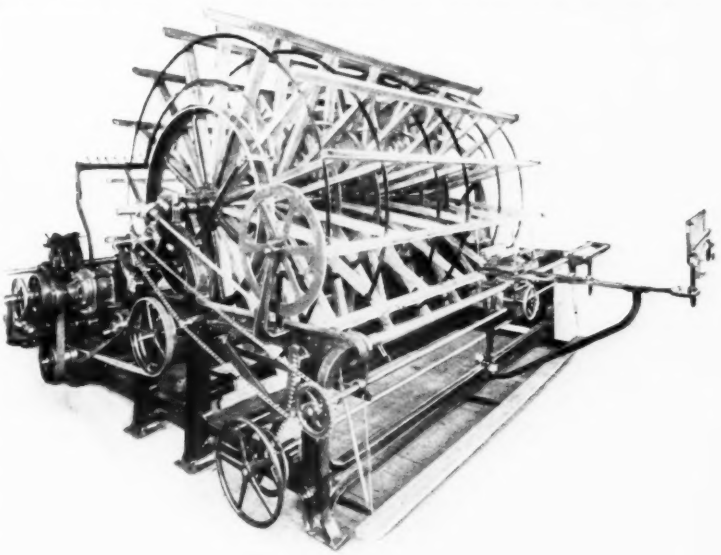
In general the modern power loom works in conjunction with a Jacquard machine, or with a shedding machine such as a dobby, according to the details of the pattern desired. For intricate designs the Jacquard must be used, but on more simple pattern work the latter device is applicable and in common usage today. The Jacquard machines employ cards in the forming of the pattern; but on dobbies and head motions the design is controlled by a pattern chain and a suitable harness or set of shafting. One shaft on a dobby or head motion loom may control any number of threads according to their appearance in the pattern. On the Jacquard machine, however, each series of warp threads is lifted individually by its own connection and these series of threads are determined according to the repetition of the pattern across the width of the goods.

The essential difficulty in the operation of a Jacquard machine is to get the pattern started properly. Usually broad silks are woven in widths from 36 to 54 inches; hence it can be appreciated that there are a multitude of warp threads to be handled. Each thread passes through an eyelet called a mail eye, in it

respective harness connection, the bottom of which is weighted to draw it down taut. The actual raising and lowering of threads according to the pattern requirements is accomplished by lifting or lowering the harness cord to which the mail eye is connected. These cords are led through a perforated board above the loom in order to maintain them in proper position, and are attached to upright wires arranged in rows on the Jacquard machine overhead. The upper ends are hooked over in order to engage with a knife or griffe which is in constant up and down motion. Adjacent to the top of each vertical hook is a horizontal cross wire capable of moving lengthwise and freeing the hook from contact with its respective griffe when necessary. The opposite ends of these horizontal wires project upon a rectangular revolving cylinder, each side of which is drilled with holes to correspond to the position of the wires. Over this cylinder the perforated Jacquard cards pass when the loom is in operation. These cards are punched in accordance with the design to be woven, and there is one card for each pick or filling thread in the fabric. In other words, if the pattern is to be several inches long there would be perhaps from 1500 to 1800 cards involved, depending on the number of picks per inch in the fabric. The cards are tied together to look somewhat like a roll of music for a player piano.

As each card passes over the perforated cylinder it is pressed against the free ends of the cross wires and wherever there is a hole in the card the respective wire is enabled to pass through. This allows the adjacent upright hooked wire to engage with its griffe, and be raised to lift its connecting cord and corresponding warp thread or threads in the pattern. Jacquard cards are so punched that there is but one hole per thread per repeat in the pattern, and only selected wires will be controlled, as explained above, to thus form the desired pattern.

Whatever the pattern controlling device, the warp is continually in a V shape prior to being embodied into the woven goods. The shuttles carry the filling (or weft) between this V by reciprocating motion. There is one shuttle per thread carrying a wound quill of the filling yarn.



Courtesy of Benjamin Eastwood Co.

Fig. 8.—Iron Frame Horizontal Warper as used in the weaving mill to reel silk warp onto the loom beam (not shown). The reel can be fitted either with standard or steel roller bearings as desired.

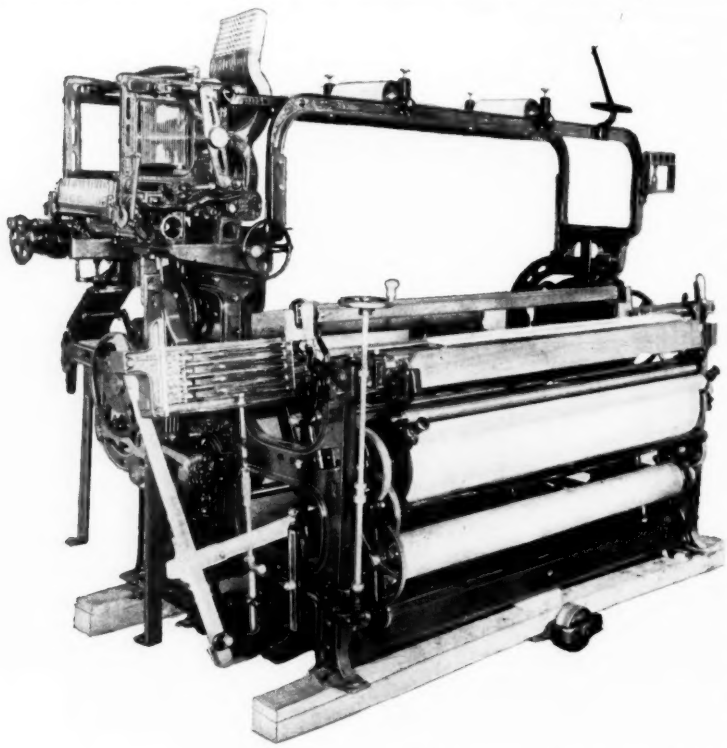
It is possible to use up to seven shuttles in the box loom. Therefore patterns of seven colors in the filling can be made. As each thread of weft is delivered by its respective shuttle it is pushed up closely into the apex of the V by a "reed" which oscillates back and forth on the lay or table of the loom. During the operation of the loom the warp beam slowly feeds its threads at the proper rate, and the woven silk is wound up on a suitable roller called a "take up".

Power looms are ordinarily driven by individual electric motors. The essential working mechanism of a loom other than explained above embodies a number of gear, cam and chain devices.

Ribbons

The weaving of ribbon is an important feature in the silk industry. Essentially the process is much similar to the weaving of broad silks, though there are certain very interesting varia-

tions in loom construction and operation. In effect, a ribbon loom is a number of miniature broad silk looms, each with its individual set of shuttles, located side by side in a common frame and operated by a common pattern and driving mechanism. From 6 to 80 ribbons can thus be woven on one loom at a time, the number depending upon the width of the ribbons. In general the maximum ribbon width is in the neighborhood of 6″.



Courtesy of Crompton & Knowles Loom Works

Fig. 9.—Type of Dobby Silk Loom as used in the weaving of broad silks, etc. In the upper left hand corner is shown the Dobby mechanism which controls the harness shafts and forms the pattern. Four shuttles are shown adjacent to the lay.

The greater percentage of the silk used for this purpose is raw product, which has been thrown before weaving. Warp or organzine is usually given a right hand twist of 16 turns per inch, then it is doubled and finally given a left hand twist of 14 turns per inch. Weft or tram is given from 2 to 6 twists and doubled. Very frequently skein dyeing is carried out also prior to weaving, though much single color ribbon is dyed in the piece where bulk stocks are made up.

Finishing

Silk as produced by the loom and the dyehouse can not immediately be put on the market; it must first be finished by stretching and ironing. In some cases after finishing, undyed woven goods are given their coloring and pattern by printing, according to the demands of the trade. Printed silks will in general show a softer effect in their patterns due to the blending of the lines of demarcation though piece print patterns will be sharper. In addition more colors are available, *i.e.*, up to a maximum of fourteen. In a later issue of LUBRICATION textile printing, which is an art in itself, will be discussed.

Finishing is usually carried out after the goods have been properly washed, rinsed and dried, using a device known as a tentering frame or else a machine built on the order of a calender or ironer. The former is a horizontal frame equipped with two parallel travelling chains which are fitted with automatic clamps for gripping the edges of the goods. This is fed to the machine from suitable rolls, and as it is secured by the clamps and carried the length of the frame it is properly heated and stretched by being led over a steam or gas heater.

In the roll finishing machine the silk receives its final stretching and pressing between heavy steel rollers. The finishing machine discharges the goods ready for marketing.

LUBRICATION

Throwing Machinery

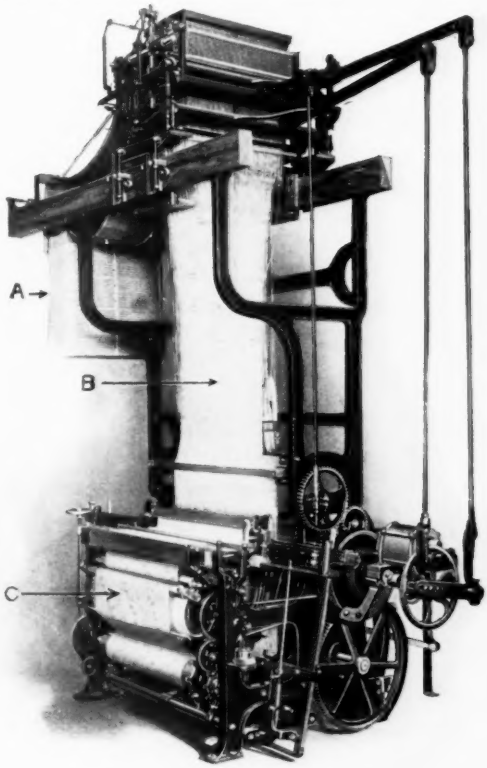
In the silk throwing plant, lubrication of the various winding, doubling and spinning machines involves a number of problems, and the use of lubricants at any time that are improperly refined or otherwise unsuited for the service may result in much loss through damage to the silks. The rapidly rotating spindles of the spinning and doubling machines require the most attention due to their natural tendency

to throw oil, hence it is most important that they be looked after by an experienced machinist who understands the principles of lubrication. Spindle oil reservoirs should never be more than half full of oil, otherwise the latter will work itself upward to drip or be thrown onto the silk threads of adjacent spindles. In modern practice the self-oiling spindle is preferred by most throwsters due to its dependability.

Best practice is to oil spindles by removing them and carefully filling the reservoir with the lubricant to the desired level. No oil should be allowed on the outside of the spindle mechanism or on the driving belt. This must be guarded against especially in replacing the spindles, which should be done most carefully to avoid splashing or possible forcing of the oil onto the whorl or the belt. By many authorities it is considered good practice to renew spindle lubrication in sequence, and not oil all at approximately the same time.

For spindle lubrication a compounded mineral oil is advisable, which has been highly refined to render it as nearly stainless as possible. The viscosity of such a product should be in the neighborhood of 100″ Saybolt at 100 deg. F. On the other hand, a pure mineral oil of a somewhat lower viscosity (*i.e.*, 60″ to 70″ Saybolt at 100 deg. F.) is used satisfactorily by many mills. Other working bearings of the spinning frame can be effectively lubricated by means of a good grade of engine oil of about 300″ Saybolt viscosity at 100 deg. F. The throwster should never make the mistake of regarding frictional spindle drives as requiring lubrication. Trouble will be bound to occur if he does, not only from slippage but also from thrown oil. These should always run perfectly dry. Such gearing and silent chain drives as are installed should be sparingly lubricated by means of a relatively heavy grade of liquid grease that will not drip. Where ball bearings are installed on the heavy bearings of spindle belt drives, etc., the lubricant should be a medium bodied grease free from acid and alkali, or a pure petroleum product of the nature of petrolatum.

Other throwing mill machinery such as winding frames, doublers, reels, warpers and water stretchers, etc., operate at relatively far slower speeds than do the spinning frames and usually give little or no lubricating trouble if the oil has been properly applied. Hand oiling of all bearings and gears is customary, and the engine oil and gear lubricant recommended for the



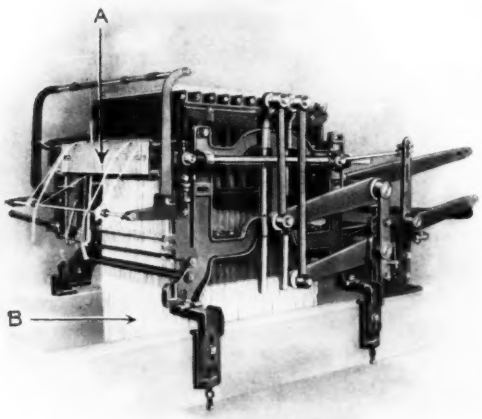
Courtesy of Crompton & Knowles Loom Works

10.—Broad Silk Loom with Jacquard Pattern Machine installed overhead. At "A" is shown the Jacquard cards referred to in the text; at "B" are the harness connecting cords, and at "C" is the woven fabric in passage to the roll.

spinner will be suitable. There is comparatively little mechanism between the supporting frames of such machines which requires lubrication, hence the chance of damaging the silk by dripped oils is reduced. Tram rings, wherever installed, should be lubricated daily, using petrolatum or a good stainless liquid grease which will keep the frictional temperature at a minimum. These rings are an important part of the equipment and frequently may give rise to trouble due to the excess heat generated by virtue of the work they do or the use of an over-sized traveler. Their lubrication is best carried out by putting the lubricant in the palm of the hand and applying it to the rings with a finger, or flexible swab. The throwster should

be careful to avoid excess lubrication of such rings, since there will be a tendency of dirt and grit accumulating on the inside to possibly stain the thread.

A word regarding the care of belts is also necessary. These should be kept absolutely free of oil and grease; else slippage and deterioration will be bound to occur. If they should become oily the free oil can usually be absorbed by holding chalk or whitening against the moving belt. Afterwards the surface should be carefully scraped with a dull knife.



Courtesy of Crompton & Knowles Loom Works

Fig. 11.—Type of Double Lift, Single Cylinder, Jacquard Machine as extensively used in weaving of intricate broad silks. At "A" is shown the perforated rectangular cylinder over which the cards pass when the loom is in operation. At "B" is shown the harness connecting cords.

Lubrication in the Dye-House

As is true in other branches of the textile industry, probably the most important lubricating problem in the silk dye-house involves keeping the oils from coming in contact with the goods in any stage of the process. For this reason it is often customary to sacrifice lubricating efficiency to some extent, and many operators have a tendency to use heavier oils on certain bearings than would otherwise be necessary, some even going so far as to use no oil at all. It is especially important in lubricating certain of the mechanism installed above the washing and coloring vats to keep the oil from dripping into the liquid. As has been said above, the purest grade of water should be used in every process, and especially for washing. If oil were to drip into the washing water it would almost surely result in ruined silks at some future stage of the process, inasmuch as the wash water is used over and over again. For this same reason steam cylinder oils in the engine room are applied somewhat sparingly, where the exhaust steam is used to heat the wash water. Oil separators are often installed, though they cannot be depended upon to remove very low percentages of oils, which would still be detrimental to the silk.

Silk dye-house lubrication can normally be carried out with three grades of lubricants, *i.e.*, cylinder oil, engine oil or grease and gear lubricant. Usually saturated steam under relatively low pressure is customary, and the steam cylinder lubricant is applied by some form of hydrostatic or mechanical lubricator, as has been explained in a previous issue of LUBRICATION.* For this purpose a compounded cylinder oil of from 130″ to 150″ Saybolt viscosity at 210 deg. F. is best suited.

Bearing lubrication should be carefully carried out due to the detrimental possibilities of dripping, as mentioned above. Hand oiling is customary on all dye-house apparatus. For this purpose a medium grade of liquid grease is advisable.

Certain of the dyeing reels and driving apparatus on the rinsing vats are motor driven through chains or gearing. There is considerable possibility of the lubricant used on these parts being thrown off onto the goods by centrifugal force. Therefore it should be selected for its adhesive properties and should be applied sparingly and evenly. A straight mineral gear compound of approximately 1000″ to 2000″ Saybolt at 210 deg. F. is customary.

Other accessory apparatus in a dye-house such as electric motors, air compressors, steam engines and hydro-extractors, should be lubricated in the usual manner for such equipment.† Extractors are similar to those used in the steam laundry, which were extensively discussed in LUBRICATION for September, 1922. Air compressors in particular require careful lubrication if water is to be pumped from wells by compressed air. The use of excess oil in the air cylinder may result in a certain amount of the

* See LUBRICATION, June, 1921.

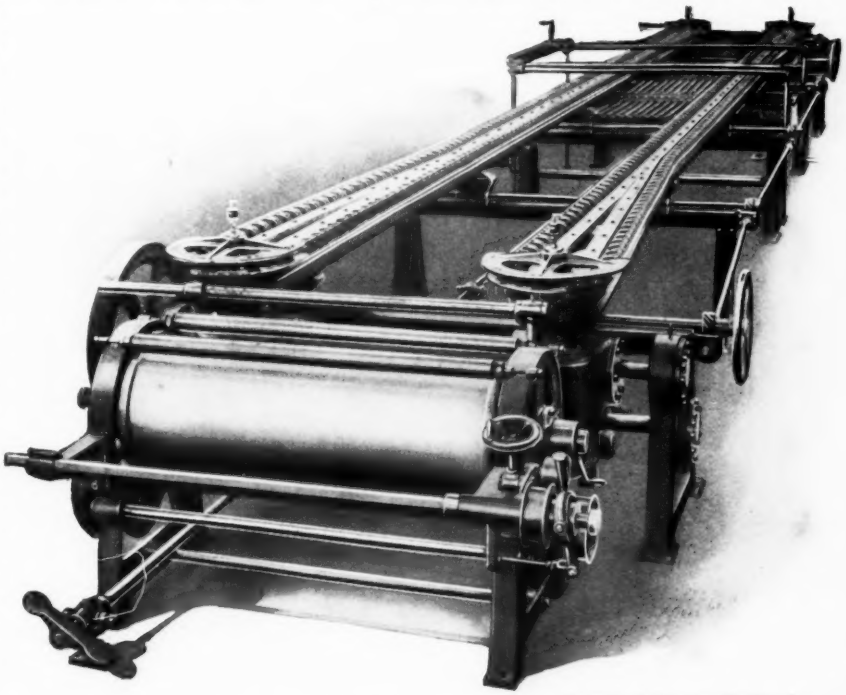
† See LUBRICATION, December, 1921 and September 1922.

oil ultimately becoming entrained in the water and damaging the silk in subsequent operations.

Weaving Machinery Lubrication

Lubrication of silk weaving machinery should essentially be carried out with a view to preventing the oil from coming in contact with the silk at any stage of the process. For this reason there is more or less of a tendency on the part of many mills to under lubricate their equipment and rather take a chance on excessive wear. Current practice is to oil loom parts such as the picking motion once or twice daily. Other wearing parts, however, may be oiled less frequently. For smaller bearings a good grade of engine oil of approximately 300″ Saybolt viscosity at 100 deg. F. is suitable. For lubrication of larger bearings such as on rolls the use of a somewhat heavier lubricant is advisable; for best results this should be a good grade of liquid grease. Gears and chains should be lubricated with a good mineral gear compound of approximately 1000″ Saybolt viscosity at 210 deg. F. which will be sufficiently adhesive to stick to the gears and not be thrown off by centrifugal force. There is very little so-called automatic lubrication in the weaving mill, and hand oiling is still the prevalent custom. In some plants each machine operator is responsible for the oiling, operation and production of his own machine. It is usually best practice, however, to have lubrication taken care of by the loom fixers in charge of the section. By so doing there will be less opportunity of trouble occurring, and greater economy of oil will be obtained.

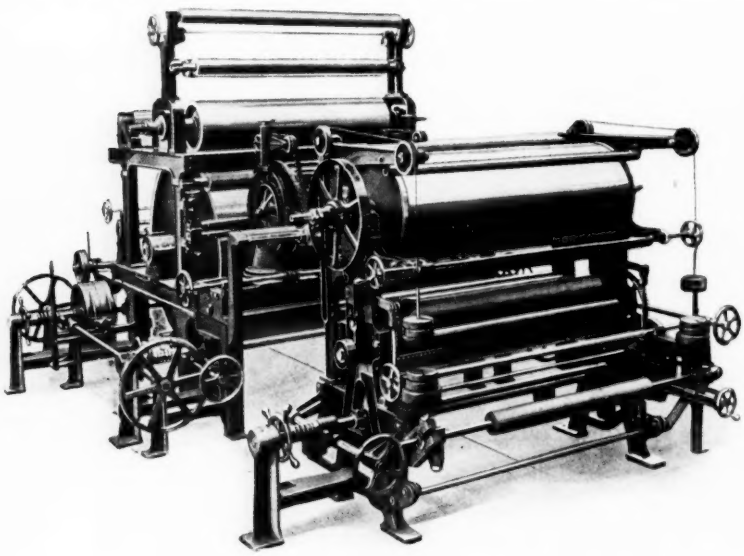
Jacquard machines require considerable care in their lubrication, and it is very necessary at all times that only the best grade of lubricant be used, and that it is applied by an experienced loom fixer. Oil should never be poured in excess upon the wires, cylinder hammers or other working parts of such a machine, due to the fact that it will at best have a certain tendency to run or drip down onto the harness connections. The presence of oil on these latter will tend to promote deterioration of the cords and result in breakage. In extreme cases such oil might even drip onto the warp or woven fabric, causing oil spots and perhaps ruining it, or at all events, entailing additional time and expense in subsequent removal. For this latter reason it is advisable to install oil pans upon the Jacquard machine supports wherever possible and see that they are kept clean and free from dust and dirt at all times. The lubricant for this purpose should be a stainless knitting oil of not over 100″ Saybolt viscosity at 100 deg. F. or a good liquid grease. The latter is preferred by some authorities due to its non-dripping tendency. Many mill operators, how-



Courtesy of Morrison Machine Co.

Fig. 12.—Illustration showing details of a Modern Tentering Frame. The chain guides on the entering end of this machine are mounted on ball bearings equipped with a lubricating system, the discharge from which furnishes lubricant for the chain as it travels over the ways. The driving head mechanism is also fitted with ball bearings and operates enclosed and immersed in oil.

ever, use the same grade of engine oil as on the loom mechanism. In event of oil drip pans being installed, such a lubricant would serve the purpose quite well, yet there is still an element of danger attached, in the possibility of oil spots occurring whatever the precautions. Hence it is safest to use the more costly, stainless oil or grease wherever possible.



Courtesy of H. W. Butterworth & Sons Co.

Fig. 13.—Silk Finishing Machine. This is an example of the roll type of finishing machine. The cylinders are built of heavy seamless steel. Operating mechanism is clearly shown.

Finishing Machinery

Silk finishing machinery usually can be lubricated effectively by means of three lubricants, *i.e.*, a liquid grease for roll bearings and other working parts adjacent to the goods and subject to excessive heat; an engine oil similar to that recommended for general lubrication elsewhere in the plant for all other bearings; and a gear compound for gears and chain drives. The finishing room will usually be subject to somewhat higher temperatures than elsewhere due to the use of steam and gas heaters, hence we must take this factor into consideration as well as the possibility of damage to the goods. Use of too light a lubricant on the tentering frame or ironing and pressing machine roll bearings might not only easily lead to abnormal wear due to lack of body in the lubricant, but as well to a certain amount of sprayed or leaked oils contaminating the goods with oil spots. For this reason a medium liquid grease such as used on comb boxes in the cotton mill is usually preferable.

Miscellaneous Machinery

In addition to the silk handling equipment discussed above, there will always be a certain amount of shafting, motors and other accessories which will require lubrication. Shaft bearings are usually of the split or solid type with provision for hand, waste pad or oil cup lubrication. On this equipment a straight mineral engine oil with a viscosity of about 300″ Saybolt at 100 deg. F. is advisable.

For electric motor bearings which may be of wick feed, ring or chain oiling type, a straight mineral engine oil with a viscosity in the neighborhood of 200″ to 300″ Saybolt will be satisfactory. The above oils can also be used on all other miscellaneous machinery requiring lubrication, as well as in the engine room.

Conclusion

It has been impossible herein to treat the silk industry in other than a general manner due to the extent of the field involved. We have therefore briefly discussed the more important processes that silk must undergo in its preparation, throwing, weaving, dyeing and finishing, to bring out the salient features of operation and lubrication. This latter is a factor throughout the industry and worthy of the care and attention of both engineers and the management. Lubrication is the keynote of production, efficiency and economy in the mill. A waste of a run of silk due to oil spots, or the tie-up of a loom or spinner due to faulty bearings might easily cost more than the plant lubrication over perhaps a year or more. Therefore it is false economy to use any but the purest and most suitable grades of lubricants at all times.

Other features of this industry such as knitting and printing, etc., will be discussed in a later issue of LUBRICATION.

Printed in U. S. A. by
EDGAR C. RUWE CO., INC.
47 West Street, N. Y. C.